Accelerator Needs and Design

Initial Experiments with CLAIRE

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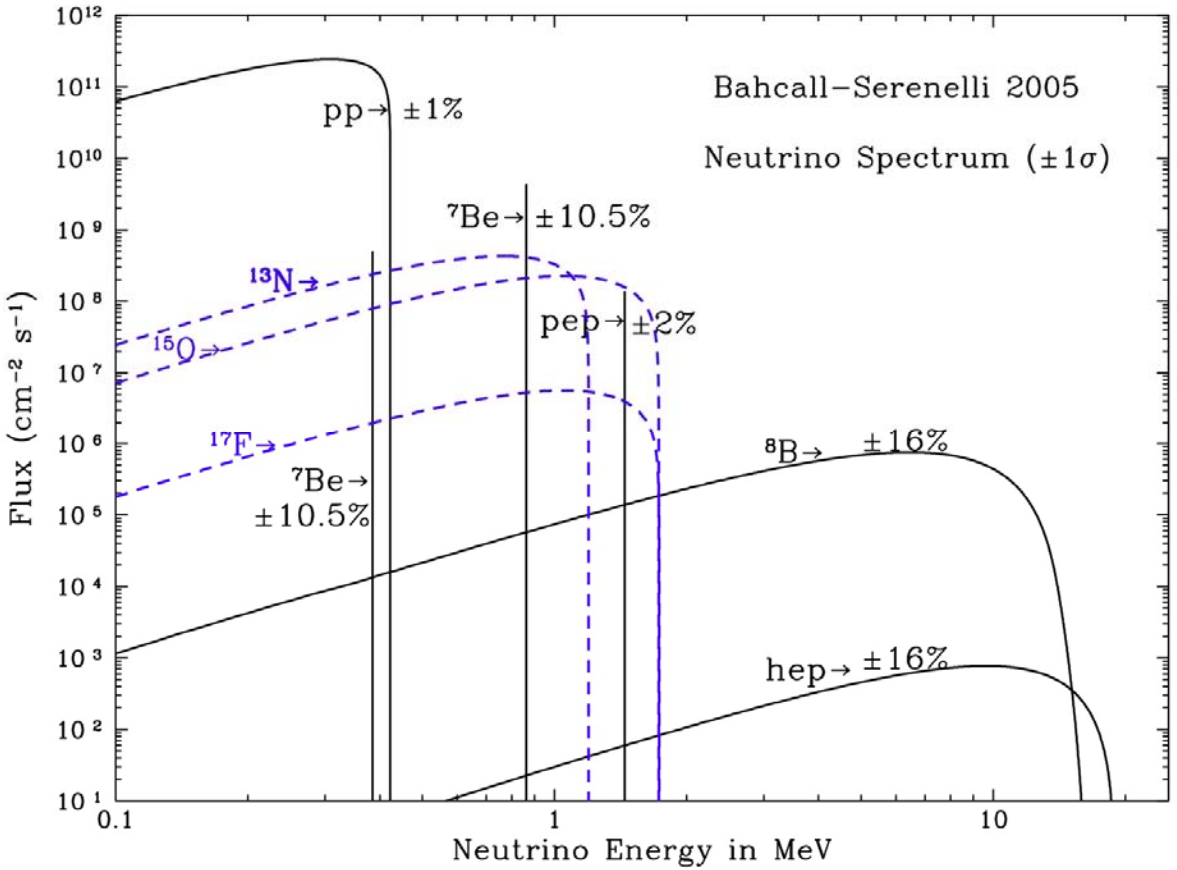
April 21-26, 2008

DUSEL Workshop
Lead, SD

Solar Neutrino Spectrum



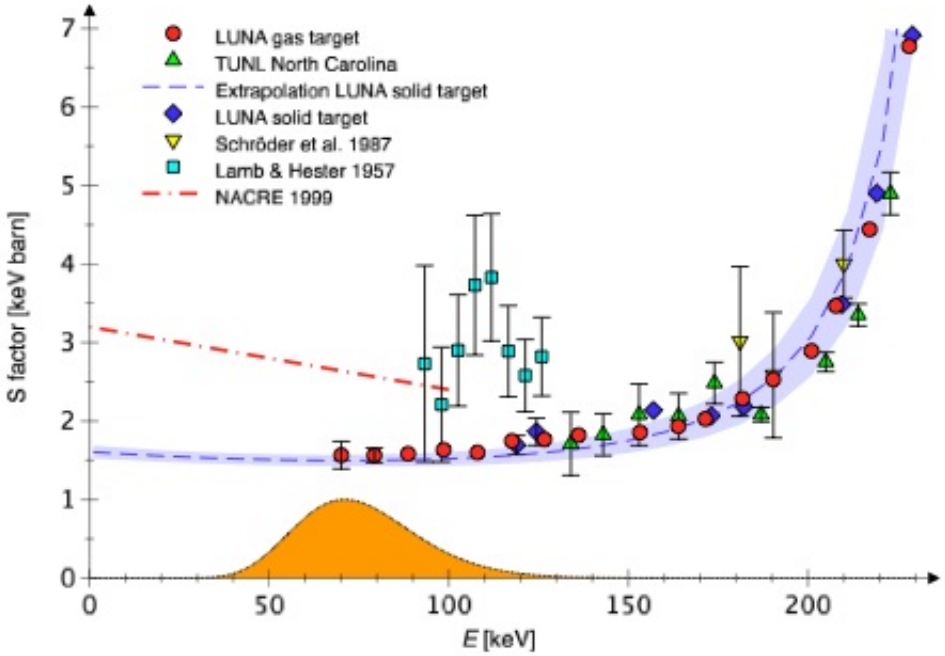
High Precision Measurement of S34

- New solar ν measurements for ^{7}Be ν's, attempts at CNO neutrinos
- ^{7}Be ν's are MSW oscillated while ^{8}B ν's are not
- Comparison of ^{7}Be, ^{8}Be ν fluxes
- SSM inputs: core temp, metallicity, Θ_{12}, MSW parameters
- Outputs: luminosity, fluxes, seismology

Solar neutrino physics is a precision measurement field.
Correlated observables, uncertainties, science rewards

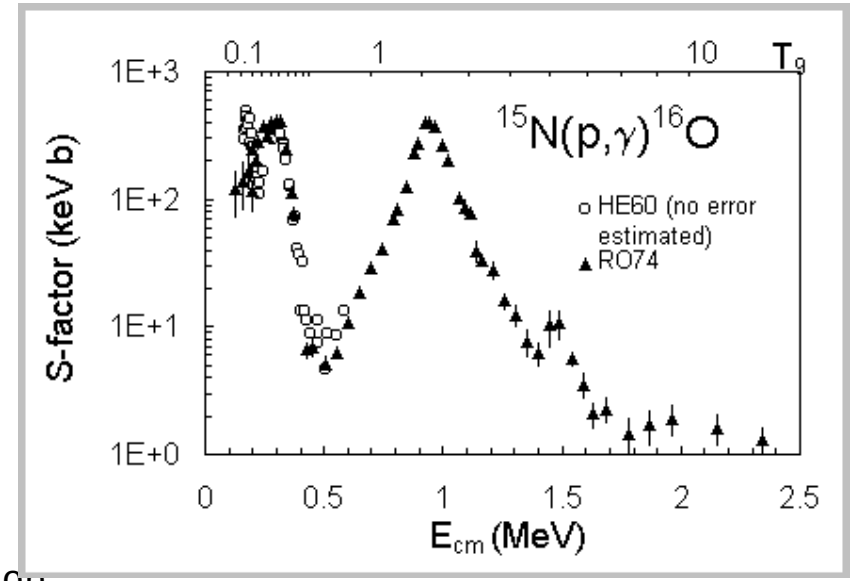
Science Motivation, CLAIRE 1 (E < 300 keV)

- High precision S34
- 14N(p,g)15O -- confirm LUNA result (CNO ν flux = ??!)



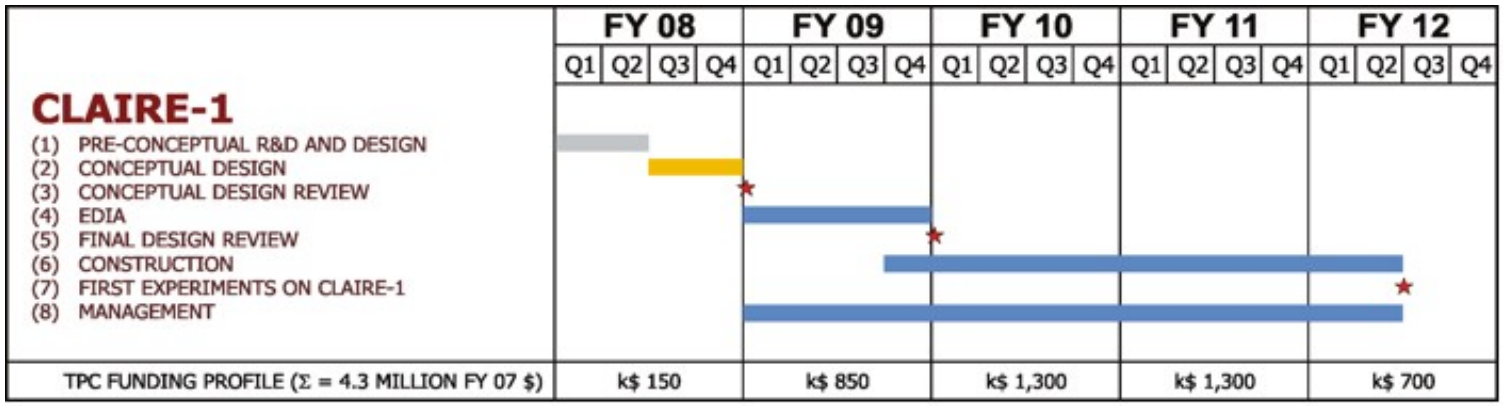
C. Broggini, *Nucl. Phys. B* **168**, 103 (2007)

- 15N(p,g)16O



CLAIRE design at LBNL

- 3 year support via Lab Directed R&D funding
- Costed design for low-energy, high-current accelerator
- Timeline for construction



Above ground estimates:

Total funding profile $4.3 M

Operating costs: 1 FTE scientist, 0.5 FTE technician

$500 k

CLAIRE Low-Energy Design

- High-intensity beam, 0-300 keV, 0-100 mA, < 1cm focus
  - Make Gamow window accessible in H/He burning reactions
- Gas jet target: 1e18 atoms/cm^2
  - High purity
  - Favorable geometry
  - Needs R&D for energy deposition, stability
- Other target options -- simpler solid, gas cell (window/less)
- Target/Detector configuration
  - HPGe -- best energy resolution, background rejection through $\Delta E/E$
  - High efficiency: BGO for high Q value reaction
  - Modular station design for simple target replacement?
  - Need R&D, planning for modules, integration with target design

CLAIRE R&D items

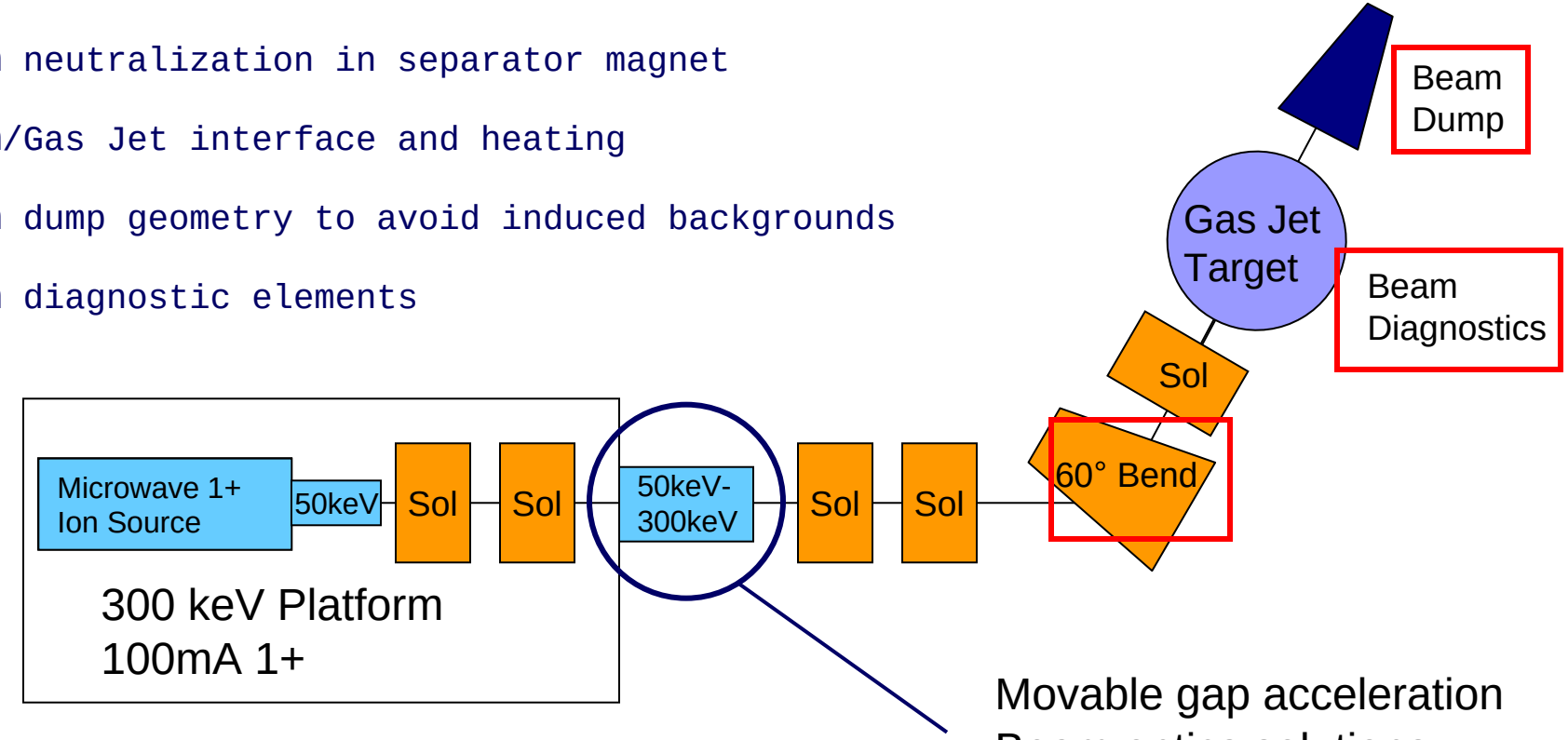
Stage 1 : Low energy option for CLAIRE, Develop Gas Jet Target

^{3}He(^{4}He, γ)^{7}Be, d(α,γ)^{6}Li, ^{14}N(p,γ)^{15}O, ^{14}N(α,γ)^{18}F, ^{15}N(α,γ)^{19}F, p(d, γ)^{3}He and d(p, γ)^{3}He

Stage 2 : Add medium charge state ECR source for energy upgrade, but much low

R&D and Specification Needs

- Beam neutralization in separator magnet
- Beam/Gas Jet interface and heating
- Beam dump geometry to avoid induced backgrounds
- Beam diagnostic elements

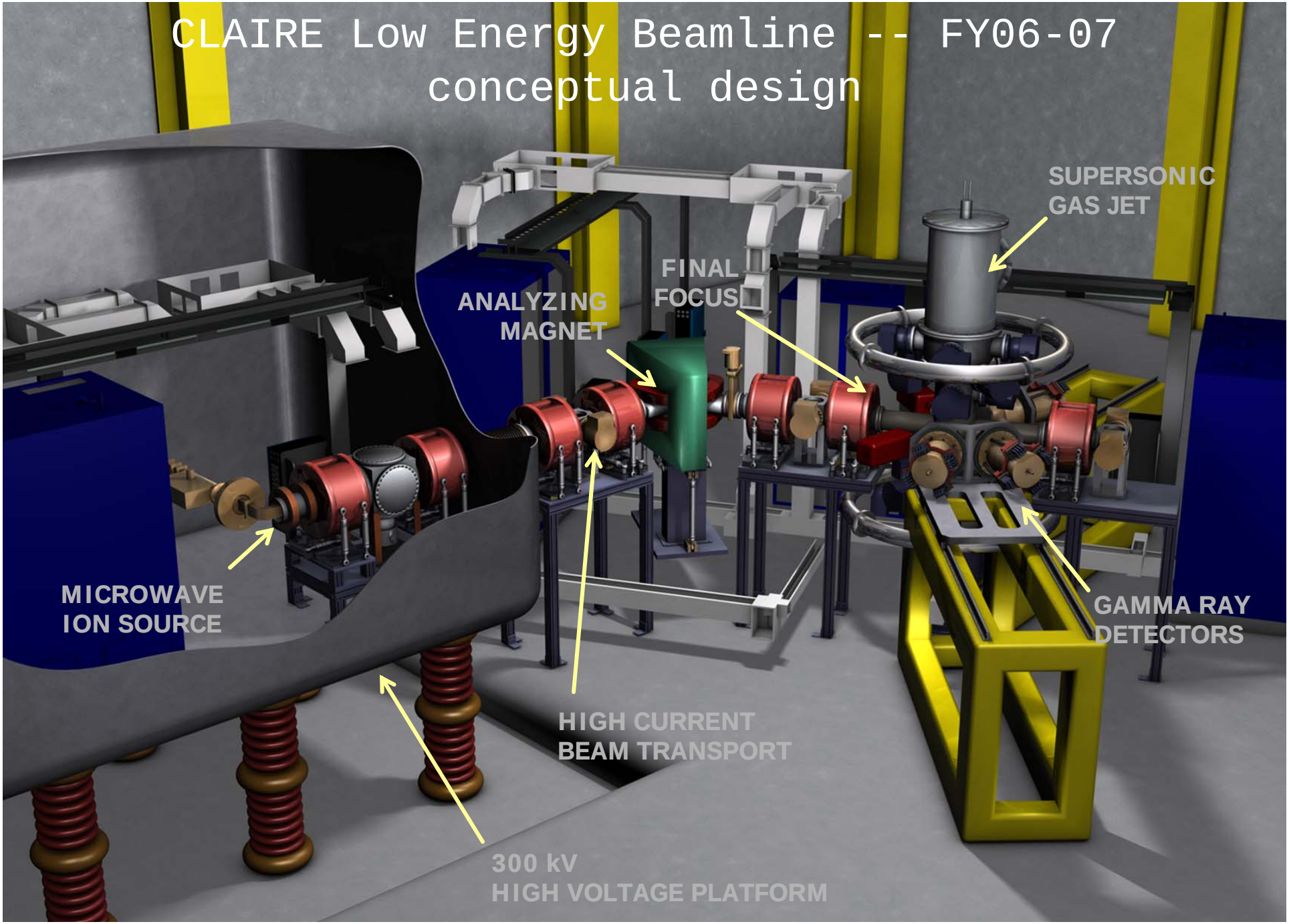


Movable gap acceleration
Beam optics solutions achieved

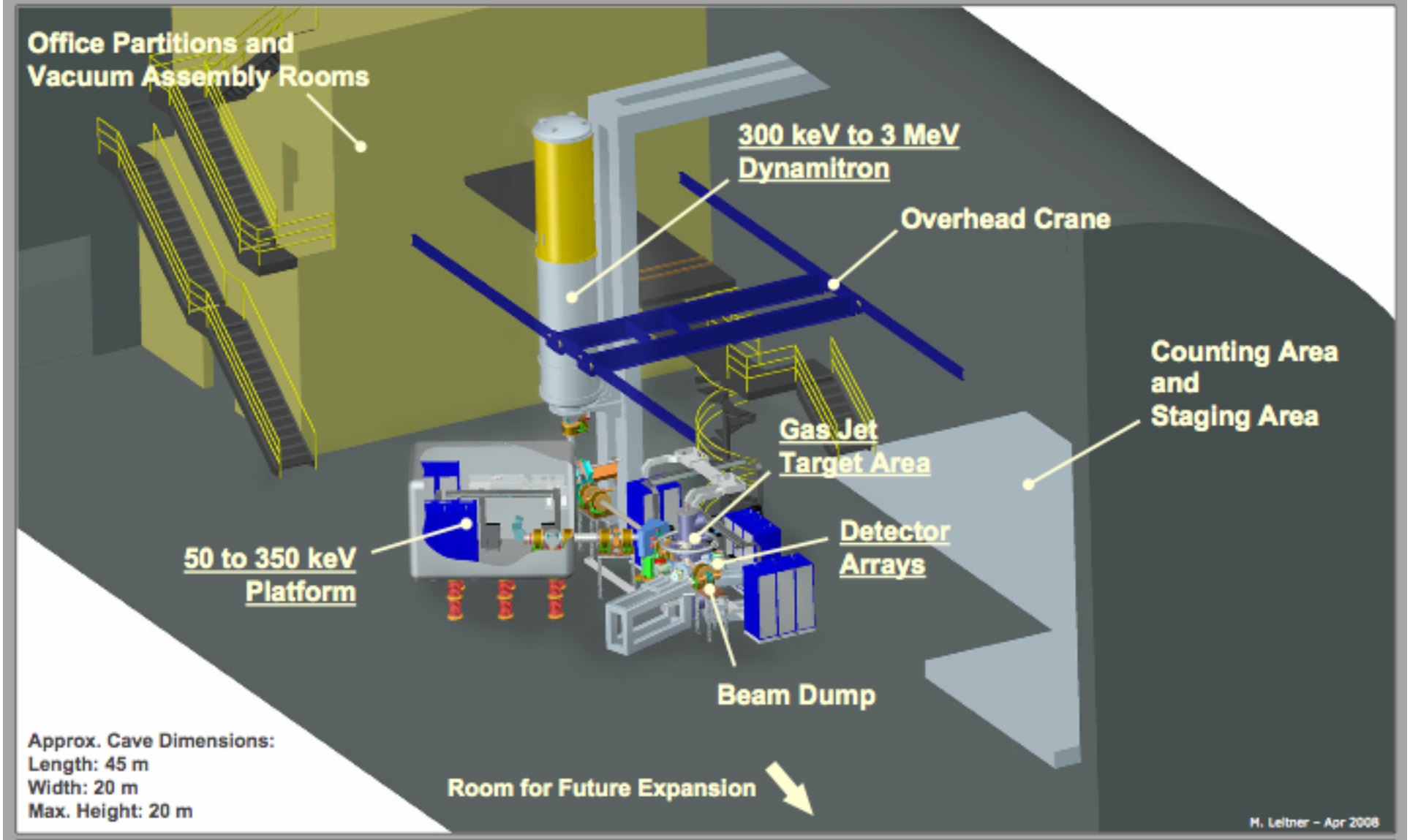
Directly applicable for the ALNA facility at DUSEL

Accelerator Specification R&D

- Other target modules -- solid, gas cell (window/less)
- Maximum beam current design
- Beam diagnostics
- Detector package -- HPGe + BGO for high Q


CLAIRE Low Energy Beamline -- FY06-07
conceptual design
SUPERSONIC
GAS JET
FINAL
FOCUS
ANALYZING
MAGNET
MICROWAVE
ION SOURCE
GAMMA RAY
DETECTORS
HIGH CURRENT
BEAM TRANSPORT
300 kV
HIGH VOLTAGE PLATFORM

UNDERGROUND ACCELERATOR LABORATORY
CAVE MODULE LAYOUT



The Underground Accelerator Laboratory

Deep Underground Science and Engineering Laboratory